Could life have emerged when the universe was at room temperature?

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Abstract

This article was inspired by the popular article *" Ask Ethan: Did life begin when the Universe was room temperature?* of Ethan Siegel. One can consider this question in both standard cosmology and in the TGD inspired cosmology. For both options, if one identifies life as chemical life, the building brick atoms of various important biomolecules should have been present at this stage of cosmological evolution.

Both options exclude the possibility that this temperature about 300 K corresponds to CMB temperature. For the standard cosmology, gravitational condensation led to the increase of the matter temperature from a value considerably below 300 K. In the simplest scenario the temperature increased up to the ignition temperature for nuclear fusion and it is difficult to understand how the biomolecules could have survived.

In TGD, the temperature T would naturally correspond to the quantum critical temperature $T_P \sim 300$ K for the Pollack effect involved with the transformation of nucleons to their dark counterparts at magnetic flux tubes. Dark nuclei would have transformed to ordinary nuclei liberating almost all nuclear binding energy. The temperature T_P would have been reached by gravitational heating and Pollack effect would make possible the generation of nuclei by dark fusion in turn forming the needed biomolecules.

The infinite number of degrees of freedom for the monopole flux tubes however implies that there is a limiting temperature T_H, known as Hagedorn temperature and nuclei could be generated solely by "cold fusion" either at the Earth or already at the Sun.

The biomolecules would have survived if T_P was slightly below the Hagedorn temperature T_H for the monopole flux tubes and therefore of the temperature of matter. Dark fusion could have generated planets and perhaps even part of the matter of the Sun. If so, the ordinary nuclear fusion could be replaced with dark fusion in TGD. Life could have emerged much earlier than in the standard cosmology.

1 Introduction

This article was inspired by the popular article *" Ask Ethan: Did life begin when the Universe was room temperature?* of Ethan Siegel (see this).

One can consider this question in both standard cosmology and in the TGD inspired cosmology. For both options, if one identifies life as chemical life, the building brick atoms of various important biomolecules should have been present at this stage of cosmological evolution.

Cosmic microwave background (CMB) was decoupled from matter at temperature 3,000 K, below which only light neutral atoms, but no molecules, were present. After that CMB temperatures decreased and at some moment it was equal to $T \sim 300$ K. The identification of the temperature T for the emergence of life as temperature of the cosmic microwave background (CMB) is excluded since no basic bio-molecules were present at that time, only simplest atoms were present. Therefore the temperature $T \sim 300$ K for matter should have emerged during the gravitational heating.

If the heating led to the ordinary nuclear fusion, it is difficult to understand how the biomolecules could have survived. In the standard cosmology this does not look plausible. Therefore the answer to the question is negative.

In TGD inspired cosmology, the temperature T would naturally correspond to the quantum critical temperature $T_P \sim 300$ K for the Pollack effect [I2, L2, I4, I3]. In TGD it would be involved with the transformation of protons to their dark counterparts at magnetic flux tubes (see [L2, L4, L19, L7, L20, L14]). Dark nuclei would have transformed to ordinary nuclei liberating almost all nuclear binding energy. The temperature T_P would have been reached by gravitational heating and Pollack effect would make possible the generation of nuclei by dark fusion [L3, L8, L5, L29] in turn forming the needed biomolecules.

One can argue that the liberated energy heats the matter to even higher temperatures and the ordinary fusion is ignited. However, the infinite number of degrees of freedom for the monopole flux tubes implies that there is a limiting temperature T_H [K2, K3], analogous to the Hagedorn temperature [B1] discovered in string models and nuclei could be generated solely by "cold fusion" without not ignition of ordinary fusion. Note that there is an entire hierarchy of Hagedorn temperatures corresponding to preferred p-adic length scales characterizing the flux tubes.

The biomolecules would have survived if T_P was slightly below the Hagedorn temperature T_H for the monopole flux tubes serving as an upper bound for the temperature of flux tubes and therefore of the temperature of matter. Dark fusion could have generated planets [L17] and perhaps even part of the matter of the Sun [L27], the physics of which could be dramatically different from that in the standard model. If so, the ordinary nuclear fusion could be replaced with dark fusion in TGD. Life could have emerged much earlier than in the standard cosmology.

In the sequel I will discuss the question "Could life have emerged when the universe was at room temperature?" in more detail from the point of views of the standard cosmology and TGD.

2 Does standard Big Bang cosmology allow emergence of life at matter temperature $T \sim 300$ K?

One can pose a long list of questions related to the notion of life. Is life Universal? Is chemical life the only possible form of life and what kinds of non-chemical lifeforms can be imagined? TGD leads to proposals for some exotic forms of life such as plasmoid life for which NASA has found empirical indications in the ionosphere [L14]. Water as such could be a primitive life form [L11, L10]. TGD also allows us to consider conscious and living computers [L26, L36] and quartz life can be imagined. Gallium based living computers could even have motor activities [L35]. These life forms would b based on the same basic mechanisms as the ordinary life.

Even if one restricts consideration to biochemical life, there is a long list of conditions to be satisfied. Sufficiently complex molecules should exist; the counterparts of DNA and other information molecules seem necessary; the analog of genetic code is desirable; the cell membrane should exist; the ability to replicate seems to be necessary; metabolism and metabolic energy sources are needed. The reason is that biochemical life requires complex chemistry made possible by stars and planets.

The Panspermia hypothesis allowing life to develop in interstellar space could be correct as also the notion of plasma life [L14, L20] suggests but does not solve the problem about the origin of biochemical life.

According to the standard cosmology, CMB decoupled from matter at $T_{CMB} \sim 3{,}000$ K. What did standard cosmology look like at $T_{CMB} \sim 300$ K? Were galaxies, stars and planets present at time? What is the CMB temperature for the most distant parts of the Universe studied now by JWST?

To answer these questions, some basic facts about standard cosmology are in order.

1. In Robertson-Walker type cosmology, there are two alternative natural time coordinates. Cosmic proper time t and the scale parameter a (which in TGD corresponds to light-cone proper time). Their relation depends on whether the cosmology is matter or radiation dominated or possibly string dominated. Matter dominated cosmology corresponds to $a \propto t^{2/3}$ and radiation dominated cosmology to $a \propto t^{1/2}$. In matter dominated cosmology, this gives for the CMB temperature the dependence

$$T_{CMB} \propto a_{now}/a \propto (t_{now}/t)^{-2/3} \quad , \quad t_{now} \sim 14Gy \quad . \tag{2.1}$$

2. Redshift-distance relation is a second useful relation.

$$1 + z = a_{now}/a(t) = T_{CMB}(t)/T_{CMB}(now) \quad . \tag{2.2}$$

   allowing to translate redshift to temperature. $T_{CMB} = 300$ K would correspond to $1+z = 100$ and $t_{now}/t = (a_{now}/a)^{3/2} = 10^3$.

   T_{CMB} does correspond to the temperature of matter, which must have been considerably lower to make possible gravitational instabilities generating gravitational condensation leading to the formation of stars and galaxies. The reason is that high temperature means high pressure gradients preventing the gravitational condensation.

3. JWST gives information about most earliest times and largest distances $z = 14.3$ is highest redshift observed by JWST (see this). This redshift corresponds to T_{CMB}= 42 K, a distance of $d = 33.8$ billion light-years, and an age of 286 million years.

   By the way, it is surprising how little we actually know about early cosmology. This gives a lot of degrees of freedom for the speculations about the earlier cosmology.

At the temperature $T_{CMB} \simeq 300$ K no molecules were present. This leaves only the option that $T \simeq 300$ K corresponds to the temperature of matter. In the standard model, stars and galaxies and planets are formed by gravitational condensation induced by gravitational instability. This requires low enough pressure and therefore a sufficiently low temperature and large enough matter clump (see this). Neutrality after decoupling makes possible the low temperature. Gravitational condensation increased the temperature and eventually ignited fusion. Could this have occurred early enough to allow $T = 300$ K as the matter temperature?

1. The ignition of ordinary fusion requires formation of stable H_2 and DH molecules. The rate for the formation of these molecules is expected to decrease with temperature since there a potential wall must be overcome. This would give a bound on the rate of temperature decrease. It is now argued on the basis of experimental data that this is not the case [E1]: the rate does not decrease with decreasing temperature. An interesting possibility is that this requires new physics [L34].

2. For chemical life to be present already at $T = 300$ K, much more complex molecules are required and the stars and even planets should have existed already at that time. This looks highly implausible. This temperature should have also occurred during the gravitational heating preceding the ignition of the nuclear fusion and it is difficult to understand how the biomolecules could have survived this heating. Bochemical life should have emerged later.

3 TGD view of cosmological evolution and biology

Could life in some form emerge at matter temperature $T = 300$ K in TGD inspired cosmology? TGD inspired views about cosmology, galaxies, stars and planets as well as about life differ dramatically from the standard views and it is not obvious what the answer to the question is.

3.1 TGD view of cosmology and formation of galaxies and stars

The TGD view of cosmology and astrophysics is described in [L24].

1. TGD provides a new view of spacetime. Space-time is identified as a 4-surface in $H = M^4 \times CP_2$ obeying almost deterministic holography realized by holomorphic reducing Riemannian geometry to algebraic geometry [L22, L28, L37]. This leads to a view in which cosmic strings, monopole flux tubes, and field bodies become new central notions of cosmology.

2. Also the hierarchy of Planck constants labelling phases of ordinary matter behaving like dark matter is an essential piece of the picture. Zero energy ontology as a new ontology of quantum theory is also a central piece having implications even in astrophysical and cosmological scales.

3. The TGD view of the formation of galaxies and stars differs from the standard view. Gravitational condensation is replaced with the TGD analog of inflation [L25, L24]. Flux tube tangles from cosmic strings decay partially to ordinary matter.

   Galaxies and stars would not have formed by gravitational condensation but by the generation of thickened tangles of cosmic strings liberating energy and generating the ordinary matter as liberated matter. These tangles could have also emerged in the intersections of cosmic strings and this option looks natural for spiral galaxies.

3.1.1 What one can say about TGD based cosmology before the formation of galaxies and stars?

Assuming TGD inspired cosmology, how much can one say about cosmology before the formation of galaxies and stars?

1. The primordial period was dominated by cosmic strings for which string world sheets had 2-dimensional M^4 projection [L24]. Einsteinian space-time emerged locally when the M^4 projection of cosmic strings increased to $D = 4$ in the formation of monopole flux tubes. In this process energy of the cosmic string was transformed to ordinary matter and it involved a serious phase transition. This process is analogous to inflation.

2. If this process indeed led to the formation of galaxies preceded by the formation of quasars, one is forced to ask whether there was any plasma period such that plasma consisting of protons and light nuclei formed by cosmic nucleosynthesis? Was there any period in which plasma consisted of free quarks and leptons? Was there any counterpart of cosmic nucleosynthesis? Was there any counterpart for the formation of neutral atoms leading to the generation of CMB?

3.1.2 TGD view of standard model physics

TGD predicts the symmetries of the standard model but the recent TGD based view of standard model physics relies on a very different view of color than the standard model.

1. This view suggests a hierarchy of hadron physics labelled by certain p-adic length scales with increasing mass scales [L12]. Could it be that the transition from cosmic string dominated phase took place as a sequence of phase transitions eventually leading to the ordinary hadron physics [L33].

2. TGD predicts only quarks and leptons and an infinite number of color partial waves in CP_2. This hierarchy of the representations of color groups give rise to an infinite hierarchy of standard model physics with an increasing mass scale [L31, L30]. There were two different phases generalizing the notions of hadronic phase and quark-gluon plasma applying to both leptons and quarks.

   One can speak of the analog of hadronic phase in which fundamental particles as external states of interactions correspond to color partial waves of fundamental fermions (quarks and leptons) in $H = M^4 \times CP_2$. The only light states are color singlets and this prediction follows from the Dirac equation in H [L30]. Colored states had masses of order CP_2 mass (10^{-4} times Planck mass).

   There was also the analog of quark gluon plasma as a phase in which quarks and leptons are massless but there are no gluons. This phase appears in particle interactions which occur as the corresponding Bohr orbit-like space-time surfaces intersect along 2-D string world sheets. String model type description applies to these interactions.

3. This forces us to ask whether cosmic evolution took place as a sequence of phase transitions in which the hadron physics with a given p-adic mass scale made a phase transition to a hadron physics with a lower p-adic mass scale. The conjecture is that preferred p-adic mass scales could correspond to Mersenne primes and the Gaussian counterparts. This process led to the ordinary hadron physics labelled by M_{107}.

   So: was there any cosmic nucleosynthesis? Does the plasma of massless leptons and quarks correspond to the plasma of quarks, gluons and leptons in the standard cosmology? Or do monopole flux tubes replace the plasma in the TGD inspired cosmology? Should one give up the narrative about the first 3 minutes altogether?

3.1.3 A new view of stars

TGD also leads to a new view of stars as monopole flux tube tangles leading to identification of blackhole-like objects as volume filling flux tubes and predicting an entire hierarchy of blackhole-like objects.

1. Solar physics involves a large number of anomalies [L27] serving as a motivation for the new vision inspired by the TGD view of star formation and cosmic evolution. For instance, there is evidence that the surface of the Sun is solid rather than plasma and that the Sun contains water. Could dark variants of ordinary atoms and molecules be in question?

2. The rather radical proposal is that a transition from M_{89} physics to M_{127} would take place in the surface layers of the star and produce solar wind and radiation [L27]. This would be a part of the process which started as a transformation of cosmic strings to monopole flux tubs and continued as a sequence of transitions in which part the energy of the monopole flux tubes transforms to ordinary matter as they thicken the p-adic characterizing them thickens.

The classical energy of the flux tube could first transform to M_{89} hadrons which then decay to ordinary hadrons by a p-adic cooling [K2] transforming the p-adic prime $M_{89} = 2^{127} - 1$ to $M_{89} = 2^{127} - 1$ characterizing ordinary hadrons.

3. Second proposal is that energy could be fed as dark energy or as M_{89} hadrons along monopole flux tubes connecting the star, say the Sun, to the galactic center or blackhole. In this picture there is no need to assume that the solar core is a seat of ordinary nuclear fusion.

4. Stars could be metabolizing systems analogous to living systems from a network connected by monopole flux tubes. Metabolic energy feed would make large h_{eff} phases inside stars which would make the number theoretically very complex and perhaps a living, conscious system, an analog of a living cell. Also dark fusion could take place both at the surface and the interior of the Sun.

3.1.4 A new view of the formation of planets

TGD suggests a new view of the formation of planets. In the TGD Universe, planets need not to be formed via the gravitational condensation of the planetary disk. The strange fact that Vega has a planetary disk but no planets [L32] gives some support for this guess.

1. The proposal is that mini Big Bangs [L17, L18] exploded layers of the star which then suffered gravitational condensation to planets. Here the dark fusion as TGD counter of "cold fusion" [L3, L8, L29] could have played a key role and generated heavier elements. Dark fusion could have occurred also at the surface of the Sun and created dark variants of the heavier elements. After a mini Big Bang giving rise to the planet, the dark nuclei would have transformed to ordinary nuclei and liberated a lot of energy.

2. If the first 3 minutes narrative is given up, one must challenge also the view about the origin of CMB. One can even imagine that there was no cosmic nucleosynthesis creating a plasma of light charged nuclei in turn forming neutral atoms leading to a decoupling of CMB.

   Nucleons could of course be present. Their density could be determined by thermodynamic considerations. If the chemical potentials vanished, standard model prediction for the densities is true. If the density of nucleons is lower than this density, chemical potentials would also characterize the situation. If the density of nucleons was much smaller than predicted by the standard cosmology, the origin of CMB is far from certain? Could the heavier nuclei have emerged in the formation of galaxies and stars as dark stellar wind transformed nuclei to ordinary nuclei?

3. Recently it was indeed proposed [E1] that CMB could contain a considerable contribution from the period when galaxies and stars formed and radiation decoupled from thermal equilibrium. A second proposal [L27] is that galactic nuclear and stars are enough for nucleosynthesis by a totally different mechanism.

   TGD could explain this contribution [L32]. $t = 500$ My is a very rough estimate for this decoupling time assignable to the formation of galaxies and stars. At that time CMB temperature would have been $T_{CMB} \sim 27$ K. Unfortunately, JWST cannot see at this distance. t could be smaller than the above estimate. The already mentioned JWST observation of the most distant object corresponds to $T_{CMB} = 42$ K, which corresponds to 286 My.

3.2 Key ideas of the TGD inspired biology

TGD inspired biology involves several new ideas such as the notion of magnetic/field body, Hagedorn temperature as limiting temperature at flux tubes, dark fusion based on Pollack effect, universal realization of the genetic code, expanding Earth hypothesis suggesting that life evolved in underground oceans [K1] [L16, L15] and plasma life [L14].

3.2.1 Hagedorn temperature

Was dark life possible before T=300 K? Did chemical life emerge at this temperature? As already explained, the requirement that basic biomolecules exist excludes the interpretation as CMB temperature $T_{CMB} \sim$ 300 K. This leaves two interpretations. The first interpretation is as Pollack temperature T_P around which Pollack effect [I2, L2, I4, I3] takes place and the second interpretation is as a Hagedorn temperature T_H [B1] associated with monopole flux tubes.

1. $T \sim 300$ K could correspond to the Hagedorn temperature T_H of the monopole flux tubes. T_H has a profound role in the TGD cosmology [L24] and TGD inspired quantum biology [L38, L39], where the aging could mean the emergence of a thermal equilibrium between the field body and the biological body.

2. At the Pollack temperature T_P, somewhat below T_H, the system is quantum critical against the occurrence of the Pollack effect. T_P could correspond also to the energy difference for the systems -OH and O^-+dark protons at magnetic flux tubes defining the analog of qubit [L26, L35]. Pollack temperature plays a key role in the TGD inspired quantum biology [L2, L4, L19, L7, L20, L14].

   T_P could be slightly below T_H as the maximal temperature to which dark fusion as TGD counterpart of "cold fusion" [L5, L3, L8, L29] could raise the temperature of the monopole flux tubes involved. The cyclotron transition energy scale at the field body could also naturally correspond to this energy scale. Indeed, in the TGD view of dark information molecules quantum communications could involve multi-cyclotron resonances [L21]. The identification $T_P \sim T_H \sim 300$ K does not lead to any obvious conflicts and looks physically more plausible.

   "Dark life" could have emerged as the planets emerged or could have emerged even in the Sun if the TGD proposal for the physics of the Sun is accepted [L27]. The dark variant of the genetic code, DNA, and proteins at the field body could exist already before this and one could consider plasma life [L14] at the field body of the Sun even before planets existed. Even the field body of the galaxy can be considered as a seat of plasma life.

This suggests that field bodies couple with biological bodies near the Hagedorn temperature T_H slightly above T_P. The coupling would involve cyclotron resonance. At the level of the cell membrane Josephson radiation modulated by the varying membrane potential would give rise to the signals coding biological information [L21].

1. Is the quantum coherence length scale determined by T_H? For $T_H \sim 300$ K, this corresponds to an IR length scale of order cell size. Does $T \leq 300$ K make possible the emergence of cell membrane like structures, Josephson junctions and Pollack effect. Is the ordinary coherence of biomatter forced by quantum coherence at the field body? The size scale of the field body would be determined by T_H. Is the quantum coherence length at the field body obtained from the coherence length at the biological body by scaling it with h_{eff}/h?

2. One can argue that the coupling of field bodies with biological bodies eventually leads to thermal equilibrium and that this means a loss of quantum coherence and death. This would occur very slowly if the temperature T at which this occurs corresponds to Hagedorn temperature. The TGD based model for aging [L39] relies on this.

3.2.2 The notions of field body and large h_{eff} phases of ordinary matter as analog of dark matter

The notion of field body distinguishes between TGD and Maxwellian (and also gauge theory view) of classical fields.

1. Field bodies can be both gravitational [L10] and electric [L14] and long range gravitational and electric fields play a key role in the TGD inspired quantum biology. Monopole flux tubes appearing as building bricks of field bodies are very special by their topological stability and exist in all scales. There exists a multitude of miracle-like numerical coincidences supporting the assumption that gravitational field bodies of the Earth, Sun and even galaxy are of special

importance. Note that the gravitational field body of the Earth does not exist before the formation of Earth.

Cells, DNA and the Earth are negatively charged and one can assign electric field bodies to these systems [L14, L23, L1] and they are expected to be very relevant for life in the TGD Universe.

2. Dark matter-like $h_{eff} \geq h$ phases are not the same thing as the galactic dark matter identifiable as TGD analog of dark energy. h_{eff} characterizes the algebraic complexity assignable to polynomials, and even rational and analytic functions with Taylor coefficients in an extension of rationals [L22, L28, L36]. The hierarchy of these extensions gives rise to an evolutionary hierarchy.

This raises interesting questions.

1. Could some field bodies have carried dark life before the emergence of chemical life at the Earth and even the emergence of the Earth? Could the gravitational magnetic body of the Sun have carried dark ions and served as a seat of prebiotic life? Could plasma life at the field body of the Sun take the role of panspermia? There is also the galactic wind: could this make possible prebiotic plasmoid lifeforms in the interstellar space?

2. The notion of plasma life [L14] is inspired by the universal genetic code in terms of hyperbolic 3-geometry [L13]. It involves in an essential way plasma phases consisting of dark ions, at least dark protons.

   TGD suggests a universal mechanism making this kind of system analogous to a hybrid of quantum computer and classical computer and providing a realization of a dark variant of the genetic code [L13, L26]. TGD inspired quantum biology indeed assumes that the dark counterpart of the basic information molecules DNA, RNA, proteins, mRNA are realized at the level of the bodies of the Sun and Earth.

3.2.3 Dark fusion

The existence of stars and planets seems to be a prerequisite for the existence of ordinary biochemical life. Dark fusion, as a counterpart of "cold fusion", claimed to occur at room temperature, could have been an essential prerequisite for their formation. This kills $Y = T_{CMB} \sim 300$ K hypothesis. One can also consider alternative, more reasonable hypotheses.

The gravitational condensation leading to the formation of planets would heat the system and could have led to temperature $T \sim 300$ K. This in turn could have led to a formation of dark matter at monopole flux tubes. If the flux tubes with infinite number of degrees of freedom had Hagedron temperature $T_H = 300$ K could be seen as Hagedorn temperature. This could have led to a dark fusion explaining "cold fusion" [L29] and producing various elements and ordinary fusion would not be needed. This could have led also to the formation of living systems via the formation of dark matter transforming them to ordinary matter.

Dark fusion could have occurred even at the surface or interior of the Sun. Dark matter at this temperature could have been generated even in the solar interior and could have made it a living system.

3.2.4 Universal realization of genetic code and $h_{eff} \geq h$ phases at field bodies as life forms

TGD suggests an Universal genetic code realized in terms of the highly unique icosa tetrahedral tessellation of hyperbolic 3-space defined by the light-cone proper time hyperboloid [L13, L9, L6]. This picture leads to a very general communication and control mechanism involving what I call N-resonance involving N simultaneous cyclotron resonances for N-photons analogous to Bose-Einstein condensates. Genetic codons would use to communications 3-resonances and genes 3N-resonances.

Could one imagine a dark counterpart of biochemistry at the field bodies?

1. I have indeed proposed that the fundamental realization of genetic code is in terms of dark counterparts of basic information molecules DNA, RNA, amino acids, and tRNA [L6]. Dark

DNA/RNA codon would correspond to entangled dark proton triplet at monopole flux tubes parallel to ordinary DNA/RNA strand. Dark codons could fuse to dark genes as quantum coherent systems.

2. They could communicate with each other by sending the dark photon counterparts of the genes as 3N-photons consisting of dark photon triplets with energies defined as cyclotron transition energies. Also the communication with ordinary information molecules could be possible.

   The receiver characterized by the similar N-codon would receive the message as resonance. The signal would be coded to modulations of the frequency scale and the signal would be coded to a sequence of pulses in the receival.

3. The basic question is whether the field bodies emerged before or after the emergence of biomatter. Long range gravitational and electric fields are needed. This would suggest that the answer is "after". Prebiotic life could have emerged before the emergence of planets at the field body of the Sun and even before the emergence of the Sun at the field body of the galaxy.

3.2.5 Expanding Earth hypothesis, Pollack effect, and plasma life

Pollack effect, the notion of plasma life, and Expanding Earth hypothesis are key elements of the TGD based view of living systems.

1. Pollack effect.

   Pollack effect and its reversal make it possible to transfer matter between biological and field bodies.

   Pollack effect [I2, L2, I4, I3] and its reversal are in a key role in the TGD inspired quantum biology [L4, L19, L7, L20, L14]. For the basic form of the Pollack effect both the Earth and the Sun and the presence of ordinary water are necessary. Pollack effect does not make sense in absence of stars and planets. As proposed, Pollack temperature could be near the Hagedorn temperature for gravitational monopole flux tubes. At the level of chemistry, the Pollack effect would naturally correspond to the flip of a topological qubit having as its bit values OH and O^- + dark proton [L26] and this means that it has many generalizations.

2. Plasma life as a predecessor of the chemical life.

   The findings of NASA [D1] (see this) inspire the proposal that plasma life obeying a dark variant of genetic code evolved in the ionosphere of the Earth [L14, L20] and migrated to the Earth.

   There are several interesting questions to be answered. Did the plasma life emerge at the field body of the Sun already before the formation of the Earth and transform to ordinary life after the mini Big Bang creating the Earth? Also the notion of quartz life could make sense [L26, L20]: how could it relate to plasma life in the ionosphere and to biological life?

3. Expanding Earth hypothesis.

   TGD also leads to a proposal that the chemical life evolved in the underground oceans [L16, L15]. Did biolife emerge after the emergence of planets or before this in the interstellar plasma? There is a long list of questions to be answered.

   (a) Were the dark protons and ions formed by dark fusion already at the surface of the Sun and gave rise to plasma life at the field body of the Sun. Was the Earth formed in a mini Big Bang for the Sun throwing out a layer which gravitationally condensed to form the Earth?

   (b) How Expanding Earth hypothesis and plasma life hypothesis could relate? How the plasma life in the monopole flux tubes was transformed to life in underground oceans? Did the dark ions end up in the Earth's interior along monopole flux tubes?

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